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	7		
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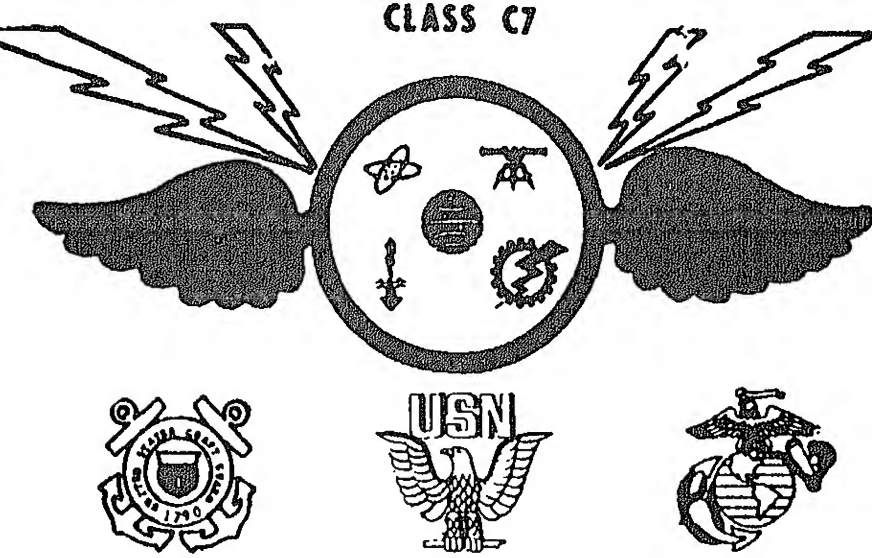
	13		

TRAINEE WORKBOOK

FOR

AVIONICS INTERMEDIATE COURSE

CLASS C7



UNIT XII

CNTT-M1659 Rev.3/84

PREPARED BY

NAVAL AIR TECHNICAL TRAINING CENTER
NAVAL AIR STATION MEMPHIS
MILLINGTON, TENNESSEE

PREPARED FOR

12.1.1A	ASSIGNMENT SHEET INTRODUCTION TO SYSTEM RADA
12.1.1I	INFORMATION SHEET
12.1.1S	STUDENT ACTIVITY GUIDE
12.2.1A	ASSIGNMENT SHEET RADAR POWER SUPPLIES
12.2.1S	STUDENT ACTIVITY GUIDE
12.3.1A	ASSIGNMENT SHEET DELETED
12.4.1A	ASSIGNMENT SHEET SYNCHRONIZER SCHEMATIC ANAL
12.4.1S	STUDENT ACTIVITY GUIDE
12.4.1I	INFORMATION SHEET
12.5.1A	ASSIGNMENT SHEET TRANSMITTER CKTS & RF DUPLE
12.5.1S	STUDENT ACTIVITY GUIDE
12.6.1A	ASSIGNMENT SHEET RECEIVER SCHEMATIC ANALYSIS
12.6.1S	STUDENT ACTIVITY GUIDE
12.7.1A	ASSIGNMENT SHEET INDICATOR VIDEO UNIT
12.7.1S	STUDENT ACTIVITY GUIDE
12.8.1A	ASSIGNMENT SHEET RANGE AND ANGLE TRACK
12.8.1S	STUDENT ACTIVITY GUIDE
12.9.1A	ASSIGNMENT SHEET A-GUN SCHEMATIC ANALYSIS
12.9.1S	STUDENT ACTIVITY GUIDE
12.10.1A	ASSIGNMENT SHEET B-GUN SCHEMATIC ANALYSIS
12.10.1S	STUDENT ACTIVITY GUIDE
12.11.1A	ASSIGNMENT SHEET INTRO TO TROUBLESHOOTING PR
12.11.1I	INFORMATION SHEET
12.11.1S	STUDENT ACTIVITY GUIDE
12.12.1A	ASSIGNMENT SHEET DELETED
12.13.1J	JOB SHEET SYSTEM ALIGNMENT AND FAM LA
12.14.1J	JOB SHEET TROUBLESHOOTING THE 11D13 T

TOPIC LEARNING OBJECTIVES:

Given a list of statements concerning the funct
Major 11D13 Radar Units, and a list of the name
the Major Units, match the unit name to its fu

Given a list of statements of characteristics
11D13 operating modes and a list of mode names,
the names to their characteristics.

Given a drawing of the Radar Display, match ea
element with its proper name. Do this for the

a. PPI Search Mode

b. Bomb Director Mode

c. Fire Control Search Sub-mode

d. Fire Control Track Sub-mode

e. Fire Control Breakaway Sub-mode

Given a drawing of the Radar Display and the p
of the range and range mark switches, select f
the range and relative bearing of the target w
radar in either the:

a. PPI Search Mode

b. Fire Control Search Mode

ASSIGNMENT:

1. Information Sheet 12.1-1I, Introduction to
   radar.

2. NAVEDTRADEV P2974-1, Maintenance Handbook,
   Dec 1968, pp 3-1 through 3-73

QUESTIONS: NONE

1. NAVEDTRA P2974-1, Dec 1968, Maintenance Handbo
11D13.

RMATION:

TRAINING USAGE

1. The RMT-FC3 is a classroom demonstrator intend
use of operational equipment for training purposes
idge between the "bread-board circuitry" of basic
ses and the functional systems of operational rada

2. In conjunction with classroom lectures and lab
device can be used effectively, both as a demonstr
machine, to satisfy passive and active training r
id design permits a variety of vacuum tubes, semic
grated circuits to be demonstrated, while multiple
litate the connection of test equipment to observe
ndividual circuit operation.

FUNCTIONAL DESCRIPTION

1. Operational capabilities of the RMT-FC3 are si
ormal, low-powered, pulsed radar systems operating
e basic modes of operation--search, fire control (
ctor (BD)--are available. The inclusion of a targ
her enhances training by allowing a synthetic targ
hree dimensions, to be developed in each of the th
ation. Training thus is independent of appropriat
ets.

2. The two most common types of radar scope prese
in this equpment: plan position indication (PPI)
lay. The device includes the elements essential t
r ranging: a transmitter, receiver, antenna, indi
nizer circuits. Additional elements include track
on, and target generation units which are provided
r operation in the fire-control or bomb-director m

te up to six revolution per minute. Manual anter
s also possible from the indicator video unit or
roup unit. Range and azimuth data are presented
d range markers are selectable in 1000-, 2000-, c
s. The B-scope is deactivated during the normal

tion in the fire-control mode uses the simulated
by the target generator unit, and involves five s
typical of operational fire control radar system
ceptor-type aircraft. These submodes permit the
be initially detected, manually tracked and acqu
natically tracked to the breakaway range (1000 ya
ta in the three possible operating ranges (0 to 1
nd 80,000 yards) are presented by the PPI display
splay on the indicator display unit. The B-scan
al-gun design which, in addition to its normal pl
steering data by means of an attack display.

peration the bomb-director mode covers the same r
in the fire-control mode. Aiming data are presen
-scan displays which are automatically altered fr
rol configuration to provide expanded sweeps. Th
a depressed-center sector scan at twice the scale
rol mode; and the B-scan reflects the target area
scale of the PPI. Both indicators include contr
azimuth strobes which act as cross-hairs to faci

ach of the trainer units poses typical radar feat
nilt into the device to facilitate training. The
antenna design, correct focus detail, rotary-joi
eneration of lobe patterns, coaxial-to-waveguide
pulse generation using magnetrons, a dummy load
ansmitter load in lieu of the antenna, modulation
discharge device, trigger generation from free-r
oscillators; synchronization of free-running rela
rs, synchronization of free-running oscillators f
zer, overload control circuits which actuate rela
rposes, and microswitch interlock protection to p
on of high voltages to exposed, critical parts of

hroughout the device, small electrical components
n removable component boards equipped with electr
l quick-disconnect units. This techniques permit
o be rendered operative or inoperative by simply
d malfunctioned component boards. These malfunct
n contain deliberately inserted defective compone
pooting phase of the training program. This manne

d troubleshooting curriculum with a gradually in
ng degree of complexity. This concept permits t
each maintenance procedures in a logical and pro
o achieve the desired level of trainee proficie

ICAL DESCRIPTION

The RMT-FC3 consists of a double rack cabinate,
obility. The cabinet is 22 inches deep by 42½ i
nches high, and weights approximately 1000 pound
assembly removed, it may be rolled through stand

The trainer incorporates design improvements res
field use of the previous model RMT-FC1 (Device
ese improvement are:

a. Target Generator:

(1) A new, greatly simplified target generat
d which utilizes completely solid state design a
use of commercially available integrated circuit

(2) The new system reduces equipment comple
provides a more versatile tool the radar instru
direct control of the important parameters requi
y demonstrate radar tracking. There is no need
tions to convert simulated target flight to desi
earing and elevation rate.

(3) Direction Coupler - The coupling has bee
12 db. This will permit utilizization of the T
.

(4) Various other circuits have been changed
ty and reliability.

re	10 db maximum
cy	30 megahertz
	4.0 megahertz
ATION	
adar	Automatic: 6 rpm clockwise Manual Slew: zero to 6 rpm either direction Manual Position: 360°
trol	Search: 60 degree sector, 2-bar scan. Sector center adjustable, ±45 degrees. Antenna nod of 6 degrees. Searchlight: ±30 degrees Tracking: ±10 degrees/second minimum
ector	Automatic 60 degree centered sector scan
	Manual tilt control ±45° ±10 degrees/second, min.
tion	Pitch: ±45 degrees Roll: ±15 degrees
	117-volt, 60-Hz, single phase, AC

Search	Cancel B-Scop Artifi Acquis
Track	B-Scop Artifi Range Range Steeri Breaka
Bomb Director	Offset Azimu Expand about cureo

RANGES

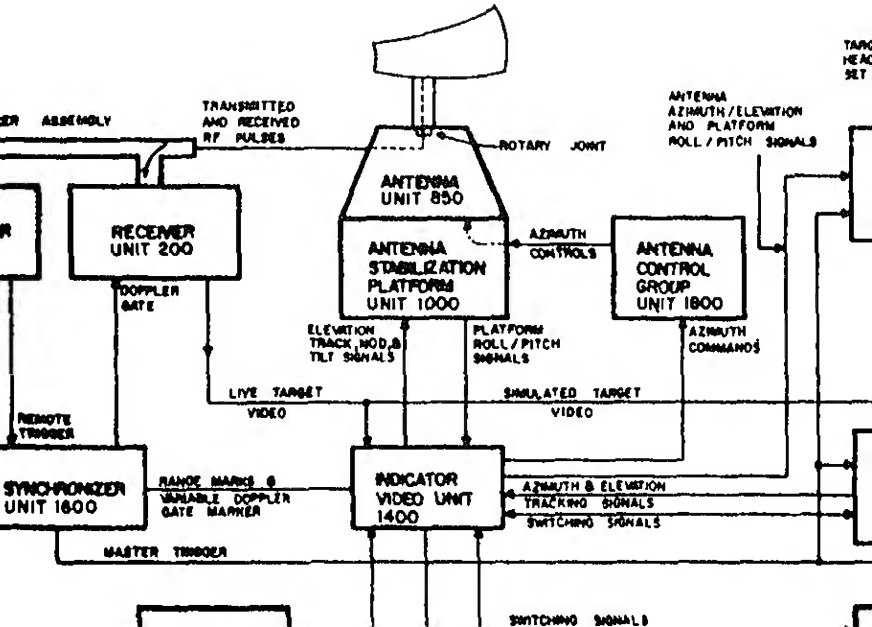
Search	6,000 12,000
Fire Control/ Bomb Director	10,000 40,000 80,000

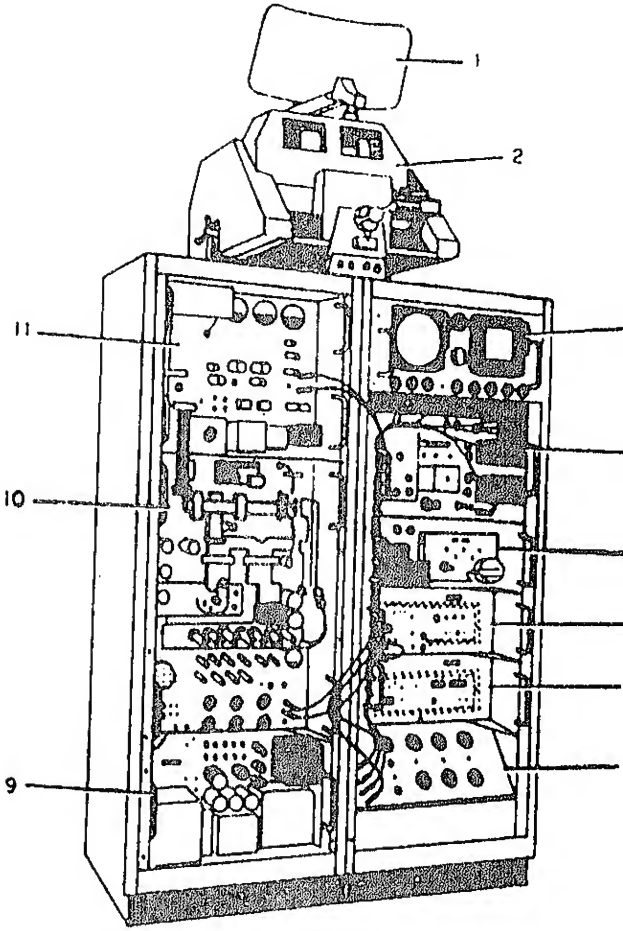
RANGE TRACKING

Speed	2000 k
Range	0 to 4

TARGET GENERATOR

Range	400 to
Bearing	0 to 3
Elevation	-45° t
Range Rate	0 to 2
Bearing Rate	0 to 1
Elevation Rate	0 to 1





1. ANTENNA UNIT 850
2. ANTENNA STABILIZATION PLATFORM UNIT 1000
3. INDICATOR DISPLAY UNIT 1500
4. INDICATOR VIDEO UNIT 1400
5. ANTENNA CONTROL GROUP UNIT 1800
6. SYNCHRONIZER UNIT 600
7. RANGE TRACKING
8. TARGET GENERATO
9. INDICATOR POWER
10. RECEIVER/DUPLEX
    200/300/900
11. TRANSMITTER UNIT

BASIC FIRE CONTROL RADAR MAINTENANCE TRAINING
DEVICE 11D13A

following list of major units of the 11D13 tra
ion:

ronizer
mitter
na
ver
ator
Supply
ator
Unit
ator
ay Unit
e Track
sis

____ generates range strobe, ampl
target video and tracks the

____ serves as interconnecting u
the trainer and provides an
control signals.

____ amplify and detects target
pulses.

____ establish time zero and dev
all timing signals for the

____ transmits r-f energy and ac
target returns.

____ develops a high frequency,
power burst of r-f energy.

____ provides visual presentatio
operator and necessary sign
the fire control displays.

____ supplies operating potentia
the Indicator Video Unit.

e following list of operating modes of the 11D13
haracteristics:

Search
Director
Control

____ has five submodes and three

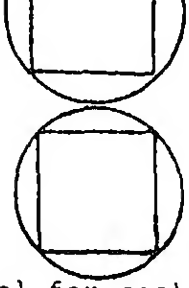
____ rotating centered sweep wit
fixed and variable range ma

____ modified, depressed center
with range cursor and three

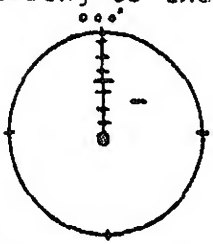
trainer display for the appropriate mode/submod
(label each waveform component)

Search

e. Fire Control Breakaway



4. Using the below drawings, label for each mode relative bearing to the target.



PPI Search
Range Switch-12,000 yrds
Range Marks-2,000 yrds
Variable Range Mark-7

F/C Search
Range Switch
Acquisition
Range Marks-

plies. The student will not troub
11D13 power supplies, but will be
them.

SSON TOPIC LEARNING OBJECTIVES:

2.1 Given the 11D13 Maintenance Handbook, a lis
functions and a list of components in the
unit, match the functions to the component

a. Half-Wave Rectifier Low Voltage Receive

Power Supply

b. Full-Wave Rectifier Low Voltage Receive

Power Supply

c. Full-Wave Bridge Rectifier Low Voltage

Unit Power Supply

d. Vacuum Tube Regulated Power Supply in t

Power Supply Unit

e. Transistor Regulated Power Supply in th

Synchronizer Unit

f. Voltage-Doubler Power Supply in the Inc

Power Supply Unit

g. RF Voltage Amplifier Power Supply in th

Power Supply Unit

b. Full-Wave Rectifier Low Voltage Transm
Power Supply

c. Full-Wave Bridge Rectifier Low Voltage
Transmitter Unit Power Supply

d. Vacuum Tube Regulated Power Supply in
Indicator Power Supply Unit

e. Transistor Regulated Power Supply in t
Synchronizer Unit

f. Voltage-Doubler Power Supply in the In
Power Supply Unit

g. RF Voltage Amplifier Power Supply in t
Indicator Power Supply Unit

nance Handbook, paragraphs 3-17 through 3-20,
n 3-46, 3-121 through 3-124, and 3-205 through

UDENT ACTIVITY GUIDE 12.2.1S

IONS: NONE

2. The -25-volt output will increase/decrease if
down the page.

3. How is Q-1631 used?

a. As a common-collector amplifier.
b. As a comparator.
c. As a common-emitter amplifier.
d. As a voltage regulator.

4. CR-1631 is a _____ -volt z

a. 12.
b. 6.3.
c. 4.
d. 10.

5. Q-1631 is d-c/r-c coupled to Q-1630.

6. Which transistor is the series regulator?

a. Q-1632.
b. Q-1631.
c. Q-1630.
d. Q-1628.
e. Q-1629.

7. Write a description of what would happen if t
increases. (Transistor power supply, 1600 uni

Answer-

8. To increase the output of V-104, you would mo
down on T-103.

a. Ture
b. False

9. How long is the time delay before 115-volts e
applied to T-106?

nction of T-106 and T-107 is _____

e 11D13) the function of T-103 is to

ntrol peak power out of V-105.
ntrol voltage supplied to T-104.
ntrol voltage supplied to Z-101.
l the above.

in 3 of T-105 is positive, CR- _____ and
t.

nction of C-104 and R-115 is _____

nction of R-116 and R-119 are _____

_____ _____.

e 11D13) M-103 monitors

tput voltage of modulator power supply.
ltage supplied to Z-101.
104 cathode current.
N charge.

s the purpose of K-101? (Refer to schematic dia
54.)

erload protection for the crystal power supply.
citation hold-in.
erload protection for the full-wave power supply
erload protection for both power supplies.

s the purpose of R-723 and R-724?

eeder resistors.
rrent-limiting resistors.
opping resistors.
ovide a complete path for current.

Answer-

22. Which winding of L-702 is the primary?

a. Pins 1 and 2.
b. Pins 3 and 4.
c. Pins 3 and 5.
d. Pins 4 and 5.

23. How does L-702 step up the +350 volts that i
plate of V-707?

Answer-

24. Where is the 4-kv output developed?

25. V-706's feedback signal is

a. the voltage developed across R-725 smoot
b. the signal coupled to L-702 pins 1 and 2
c. RC coupled through C-719 to the cathode.
d. coupled through C-714 and C-713 to the g

DELETED

LESSON TOPIC LEARNING OBJECTIVES:

12.4.1 Given the 11D13 Maintenance Handbook, block diagram of the synchronizer and ments concerning the functions of the the name of the block to its function.

12.4.2 Given the 11D13 Maintenance Handbook a symptoms, select from a list the fault in the:

a. Basic Trigger Generator Circuit

b. Delay Trigger Circuit

c. Master Trigger Circuit

d. Range Marks Circuit

e. Sweep Gate Circuit

f. Sweep Generator Circuit

g. Marks Mixer Circuit

STUDY ASSIGNMENT: Read: NAVTRADEV P-2974-1 M Handbook, Device 11D1 through 3-25.

Complete: Student Activity Guid

STUDY QUESTIONS:

1. Why is it important for the sweeps on start at the same time the transmitter
2. What is the PRF of the signal from the oscillator?
3. What is the purpose of having a delaye fire the transmitter?
4. What is the output frequency of the ri oscillator?

at range separation?
at type of oscillator does Q1612 and its associ
rcuitry comprise?
at type of circuit is Q1620/Q1621?
at is the purpose of Q1615?

1. What is the purpose of the synchronizer (

2. Q-1618 and associated components comprise
   a. free-running single-cycle blocking os
   b. pulsed Hartley oscillator.
   c. free-running Hartley oscillator.
   d. triggered single-cycle blocking oscil

3. The frequency of oscillations from the ra
   oscillator is
   a. 6.18 kHz.
   b. 16.18 kHz.
   c. 161.8 kHz.
   d. 61.8 kHz.

4. Delay Multivibrator (Q-1606, Q-1607) prod
   square wave whose pulse width is adjustab
   to _____ microseconds.

5. The range of the VRM is controlled by pot
   _____.

6. The PRF of the synchronizer reference osc
   a. 1000 kHz.
   b. 1 MHz.
   c. 1000 Hz.
   d. 100 kHz.

7. The signal present at J-1612 is
   a. negative 1 μsec pulses occurring at
   b. positive 1 μsec pulses occurring at
   c. positive 1 μsec pulses occurring at
   d. positive pulses variable from 2 to 6

8. In the reference oscillator, the parallel
   provides a path for
   a. noise.
   b. regenerative feedback.
   c. degenerative feedback.
   d. both b and c above.

b. negative spikes.
c. positive sawtooths.
d. negative sawtooths.

C-1608 and R-1619 form a _____ networ
a. differentiating
b. coupling
c. clamping
d. intergrating

The output of Q-1614 is a _____.
a. positive pulse.
b. negative pulse.
c. positive sawtooth.
d. negative sawtooth.

Q-1606 and Q-1607 comprise a/an _____
multivibrator.
a. astable
b. bi-stable
c. monostable
d. quasistable

The quiescent condition of Q-1606 and Q-1607 is
_____, Q-1607 _____.
a. conducting, cut off
b. cut off, conducting
c. conducting, conducting
d. cut off, cut off

The quiescent condition of Q-1609 is
a. saturated.
b. conducting.
c. cut off.
d. on, then off.

During normal operation, the ringing oscillator
oscillate for at least _____ μsec every _
μsec.
a. 80, 1000
b. 6.18, 1000
c. 12.36, 80
d. 18.54, 1000

_____ as determined by _____.

a. 162 kHz, 81 kHz, 54 kHz, S-1602
b. 1 kHz, 81 kHz, 54 kHz, S-1602
c. 162 kHz, 81 kHz, 54 kHz, S-1604
d. 162 kHz, 1 kHz, 54 kHz, S-1604

19. S-1604 is in the 6000-yard position. The pulse out of Q-1627 will be
a. 12.36 μsec.
b. 74 μsec.
c. 37 μsec.
d. 6.18 μsec.

20. Linearity is improved in the output sawtoo because of feedback supplied by
a. C-1632.
b. C-1631.
c. C-1630.
d. C-1633.

RENCES: 1. NAVTRADEV P-2574-1, MAINTENANCE MAN
11D13A, DEC 1968, pages 3-17 and 3-
2. ELECTRONIC CIRCUIT ANALYSIS, NAVWEP
79, 1962, VOL I, Chapter 8, pages 8
8-47.

ORMATION:

1. This discussion concerns the operation of a
lizing the band-rejection characteristic of a pa
ter. This filter is sometimes referred to as a
has the characteristic of rejecting a narrow ba
quencies. The twin-T filter consists of a high-
ter and a low-pass T filter in parallel as illus
ure 1.

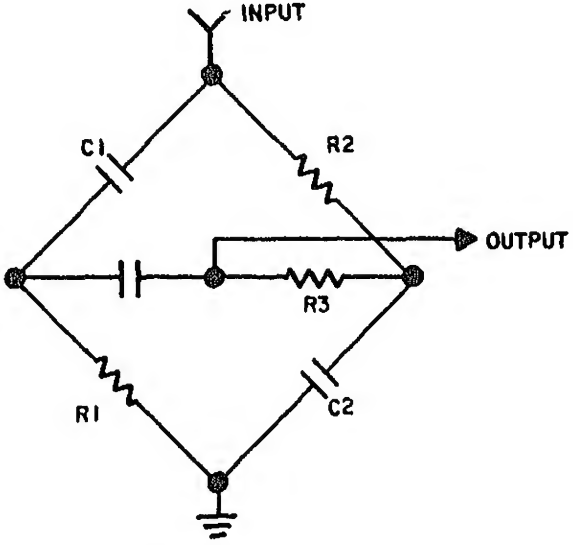


Figure 1

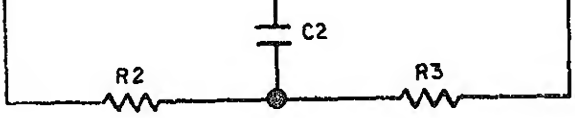


Figure 2

An ideal set of component relationships is cho
cilitate the analysis but it should be realized
jection of a frequency can occur for a wide rang
lue relationships. For purposes of this analysi
all assume that the following conditions exist a
jection frequency which we shall call F_r. At F_r
ual to R1, X_{c2} is equal to R2, X_{c3} is equal to R
lues of X_{c3} and R3 are very large compared to th
lues.

A signal (F_r) applied at the input has two pos
travel, C1-R1 and R2-C2. We shall first consid
th. With X_{c1} equal to R1, the voltage across R1
e applied voltage by 45°. The voltage across R1
ffectively applied across the network of C3, R3,
nce X_{c3} and R3 are very large compared to X_{c2} th
ross R3 will lead the voltage across R1 by 45°.
nce X_{c2} is not significant compared to R3, the v
op across R3 can thus be considered the output v
nce the voltage across R1 leads the input by 45°
oltage at the output must lead the input by 90°.

(-90° one path, +90° the other path) and will
oducing no signal at the output.
quencies other than F_r, the two signals arriving
put will not be 180° out of phase and thus will n
requencies close to F_r are highly attenuated, wit
ess attenuation as the frequency is further and
moved from F_r. For value relationships other tha
in this discussion, the analysis is more complex
nput impedance of the Field Effect transistor is
n amplifier to be used with this filter, because
ligible loading effect on the output of the filte

LESSON TOPIC LEARNING OBJECTIVES:

12.5.1 Given a list of statements concerning the funct
select the correct statements.

12.5.2 Given the 11D13 Maintenance Handbook, the diagr
transmitter (including the Magnetron and Direct
and a list of statements concerning the functic
match the name of the block to its function.

12.5.3 Given the 11D13 Maintenance Handbook and Troubl
from a list the faulty component(s) in the:

a. Modulator Power Supply

b. Transmitter Trigger Generator

c. Modulator

d. Magnetron Circuits

STUDY ASSIGNMENT:

Read:

1. NAVEDTRADEV P2974-1, Maintenance Handbook,
1968, pp 7-15 through pp 7-18.

STUDY QUESTIONS: NONE

The function of S-103 and S-102 is _____

The function of F-101 and F-102 is _____

The function of T-106 and T-107 is _____

V-101A is a _____ used only when

cycle blocking oscillator is _____

The signal coming on pin 2 of V-101A is a _____

delay _____microseconds from _____

What action causes V-101B to go into saturation rapidly?

In a free-running condition, the time between out

from V-101B is determined by _____ and

When pin 3 of T-105 is positive, CR- _____ and C conduct.

The function of C-104 and R-115 is _____

The functions of R-116 and R-119 are _____

_____ _____.

V-103 is ionized by +1000 volts on its plate.

a. True.

b. False.

_____ excite the _____ into

17. The PRF of a driven single-cycle blocking
termined by

18. Pulse width of a single-cycle blocking osc

mined by the _____ and _____

the transformer.

19. The synchronized frequency of a single-cyc
oscillator is higher/lower than the free-r
Why?

20. The driven blocking oscillator operates on

21. A duplexer could be referred to as a/an

a. receiving device.

b. transmission line.

c. electronic switch.

d. transmitter

What is the main purpose of a duplexer?

a. A protection device

b. Transmission of r-f energy

c. To increase receiver sensitivity

d. The use of one antenna for both TX and RX fi

Keep-alive voltage applied to the TR tubes keeps

a. sufficiently warm.

b. glowing.

c. deionized.

d. near ionization.

When the TR tubes are becoming defective, the fi
indication will be

a. loss of minimum-range targets.

b. loss of maximum-range targets.

c. smoke coming from the waveguides.

d. a bright spot on the CRT.

If faulty TR tubes are not recognized and replac
enough, this could result in

a. a defective antenna.

b. defective and arced waveguides.

c. weak targets displayed.

d. no targets displayed.

b. open.

c. mismatched.

d. matched.

29. (Device 11D13) the function of T-103 is to

a. control peak power out of V-105.

b. control voltage supplied to T-104.

c. control voltage supplied to Z-101.

d. all the above.

30. (Device 11D13) Z-101 is a/an

a. open-end transmission line.

b. shorted-end transmission line.

c. open-end artificial transmission line.

d. shorted-end artificial transmission line.

31. (Device 11D13) A function of L-101 is to allo charge to approximately

a. the voltage supplied the PFN.

b. twice the voltage supplied the PFN.

c. three times the voltage supplied the PFN.

d. four times the voltage supplied the PFN.

ice 11D13) V-103 provides Z-101 with a

fast discharge path during transmit time.

fast discharge path during rest time.

slow discharge path during transmit time.

slow discharge path during rest time.

ice 11D13) M-102 monitors

peak current

average current.

peak voltage.

average voltage

ice 11D13) T-102 has a one-to-

one ratio.

two ratio.

three ratio.

four ratio.

ice 11D13) 250 volts is suppled to the modulator
modulator power supply. How much voltage is felt
cathode of V-105 during transmit time?

250 volts.

500 volts.

1000 volts

2000 volts.

c. Z-101 charge current.

d. Z-101 inverse current.

38. (Device 11D13) M-103 monitors

a. output voltage of modulator pow

b. voltage supplied to Z-101.

c. V-104 cathode current.

d. PFN charge.

39. Minimum range of a radar set is det

a. PW.

b. d-c.

c. PRF.

d. PRT.

40. Maximum range of a radar set is det

a. PW.

b. d-c.

c. PRF.

d. PRT.

41. Pulse width of a radar set is deter

a. synchronizer.

b. PFN.

c. modulator power supply.

d. switch tube.

ncrease the output of V-104, you would move the w
down on T-103.

True

False

long is the time delay before 115-volts excitatio
ied to T-106?

is the purpose of K-101? (Refer to schematic di
on P. 53/54.)

Overload protection for the crystal power supply.

Excitation hold-in.

Overload protection for the full-wave power suppl

Overload protection for both power supplies.

ESSON TOPIC LEARNING OBJECTIVES:

2.6.1 Given the 11D13 Maintenance Handbook, a blo
of receiver and a list of statements concer
functions of the blocks, MATCH the name of
to its function.

2.6.2 Given the 11D13 Maintenance Handbook and Tr
Symptoms, SELECT from a list the faulty com
in the:

a. AFC circuits
b. IF amplifier circuits
c. Video circuits
d. Doppler circuits

Read: NAVTRADEV P-2974-1 & 2, Maintenance Handbook
11D13A, Dec. 1968, pp 3-6 through 3-10, 7-19

Complete: Student Activity Guide 12.6.1S

STUDY QUESTIONS: NONE

Wave length.

t section of the radar receiver should be rigidly
trolled to maintain a good signal-to-noise ratio?

Second detector.
Local oscillator.
I-F amplifier.
Preamplifier.

ng balanced mixers, a minimum of noise is produce
oss the i-f transformer because

i-f components of noise are out-of-phase.
i-f components of noise are in-phase.
local oscillator components of noise are out-of-
local oscillator components of noise are in-phas

using a balanced crystal mixer in a radar receive
se generated by the _____ is greatly re

magnetron
mixer
klystron
ground return

e the main purpose of the cascode amplifier stage

Decreases noise level.
Amplifies the 30 mc signal.
Sets high signal-to-noise ratio (affecting maxim
range.

conventional pentode amplifiers in a cascade con
n allows a bandpass of _____ by
_____ the plate circuits. (11D13)

t is the function of diode detector (CR 901)? __

system is to

a. keep the klystron at the same frequency, re
magnetron frequency.
b. keep the magnetron on frequency.
c. keep the i-f constant.
d. provide synchro pulses for the sawtooth gen

1. The proper output from a discriminator at the r
frequency is

a. positive pulses only.
b. negative pulses only.
c. zero voltage.
d. positive or negative pulses.

2. In a difference afc system, the sweep to the re
plate will

a. be below the LO frequency to lock in.
b. be above the LO frequency to lock in.
c. always pass through the proper LO frequency
d. not lock in unless manually tuned.

3. AFC systems may be classified as either a _____

frequency system or a _____ freq

4. The output of a discriminator depends upon

5. When using the phantastron afc system, at the m
the sweep generator plate swings in a positive
the local oscillator is (more/less) than one i-
the transmitter frequency.

omponent establishes the predetermined operating
or AGC bias?

oose of C-201 and R-219 is for _____

_____.

the purpose of diode CR-201?

ding edge of the STC wave form represents what?

mponents determine the duration of the STC pulse?

mponent governs the operating level of the STC pul

12.7.1 Given the 11D13 Maintenance Handbook, the
and a list of statements concerning the fu
the blocks, match the name of the block to

12.7.2 Given the 11D13 Maintenance Handbook and
symptoms, select from a list the faulty co
in the:

a. PPI Sweep Generation Circuits

b. PPI Drive Circuits

c. Azimuth Maker Generator Circuits

d. Video Amplifier Circuits

STUDY ASSIGNMENT:

1. Maintenance Handbook, Device 11D1
P-2974-1 & 2, Dec 1968, pp. 2-21
3-54 through 3-61, 4-7, 4-8, and
7-42F.

Student Activity Guide 12.7.1S

STUDY QUESTIONS: None

negative trapezoid.

signals present at TP-1403 and TP-1404 are (1400 u

in-phase.
90° out-of-phase.
180° out-of-phase.
45° out-of-phase.

33 is adjusted for

North-South offset for sweep in BD mode.
North-South offset for sweep in PPI Mode.
East-west offset for sweep in BD mode.
East-West offset for sweep in PPI mode.

y K-1404 is energized in

BD mode.
SEARCH mode.
FC mode.
all modes.

electrical length of the PPI sweep (1400 unit) is
rmined by the

electrical position of B-1403.
physical position of B-1403.
pulse amplitude at TP-1402.
pulse duration at TP-1402.

physical length of the PPI sweep (1400 unit) is de
d by the

electrical position of B-1403.
physical position of B-1403.
pulse duration at TP-1402.
none of the above.

8. The duration of the unblanking pulse to the
indicator is determined by:

a. S-1502A.
b. S-1502B.
c. S-1401.
d. R-1505.

9. The azimuth mark generator's output is displ

a. FC and PPI indicator in FC mode.
b. FC and PPI indicator in BD mode.
c. FC and PPI indicator in all modes.
d. PPI indicator in BD only.

10. R-14111 (1400 unit) will vary the intensity

a. video displayed on the FC and PPI indica
b. video displayed on the PPI indicator onl
c. azimuth marker displayed on the FC and P
d. azimuth marker displayed on the PPI indi

11. The slope of the sawtooth out of the sweep g
determined by the setting of:

a. S-1502A.
b. S-1502B.
c. S-1401.
d. all of the above.

C1408
R1405
R1437
CR1401

e positive square wave coming out pin 9 J1511 on the A15
oduced by what type of circuit?

Schmitt Trigger
Astable Multivibrator
Bistable Multivibrator
Monostable Multivibrator

th the wiper arm (pin 2) of R14108 moved down to pin 3,
missing on the A-Scope?

Fixed Range Marks
Variable Range Mark
Azimuth Mark
Target

1, CR2, and R9 on the A1404 Board comprise what type of

Nand Gate
Steering Circuit
And Gate
Comparator

R1404 is a _____ _____ diode acting as a _____

15 Volt Zener; Clamper
5 Volt Zener; Limiter
15 Volt Zener; Limiter
5 Volt Zener; Clamper

1434 is used as a _____ _____ adju

B/D East/West Center
PPI East/West Center
B/D North/South Center
PPI North/South Center

A. PPIis selected
B. S1407 or S1408 is closed
C. in Auto-Track Submode
D. None of the above

20. J1414 pin 6 is an Input to the 1400 Unit when_____

A. Low power is turned on
B. Auto-Track Submode is initiated
C. in F/C Search
D. in PPI Search

LEARNING OBJECTIVES:

the 11D13 Maintenance Handbook and Trouble Sym
t from a list the faulty component(s) in the Ra
Track Unit.

the 11D13 Maintenance Handbook, the block diag
t of statements concerning the functions of the
the name of each block to its function for the
or submode circuits.

omb Director Mode

ire Control Automatic Search Submode

ire Control Acquistion Submode'

ire Control Automatic Track Submode

ENT:

. Maintenance Handbook, Device 11D13A, NAVTRADE
P-2974-1, Dec. 1968, pp.3-61-3-73.

. Aviation Fire Control Technician 3&2, NAVPER
pp. 485-489.

Student Activity Guide 12.8.1S

NS: None

c. used only in bomb director mode.

d. applied to the cathode of CR-1926.

2. The output of Q-1907 is

a. positive and negative range strobes.

b. 2 μsec in duration.

c. taraget video.

d. one microsecond, negative range strc

3. Maximum current flows through the range

a. range strobes are present.

b. locked-on.

c. range strobes are not present.

d. the gate diodes conduct.

4. The output of the range track error dete

a. acceleration.

b. range.

c. velocity

d. distance.

5. Bipolar video is used to

a. select a target.

b. operate coincidence gate.

c. range track.

d. angle track.

. By CR-1906.

ne output that controls range circle size is
. at J-1907, pin 4.
. negative pulses.
. from collector of Q-1912.
. negative d-c volts.

n fire control search sub-mode, K-1903 is
. held deenergized by output of Q-1913.
. as shown on block diagram.
. energized.
. not involved.

ith no range strobe applied, CR-1901
. conducts.
. is cut off.
. couples the signal.
. forward bias's Q-1904.

-1927
. conducts until breakaway range is reached.
. is an NPN transitor.
. is normally forwarded biased.
. conducts when breadaway range is reached.

d. Q-1907's output is a minimum of

12. For a closing target, the output of
    a. Q-1909 is positive.
    b. Q-1908 is positive.
    c. Q-1910 is positive.
    d. C-1910 is positive.
13. Bipolar video is delayed .3 μsec by
    a. DL-1901.
    b. DL-1902.
    c. inherent circuit delays.
    d. CR-1907 and CR-1910.
14. Q-1906 functions as
    a. a paraphase amplifier.
    b. an amplifier.
    c. a switch.
    d. an isolation device.
15. Q-1903 is
    a. an emitter follower.
    b. A C.E. amplifier.
    c. a switch.
    d. half of a multivibrator.
16. What is the purpose of Q-1916?

polar video is

used in the TRACK sub-mode.

sent to the indicator display.

created by DL-1902.

used in the SEARCH sub-mode.

the TRACK sub-mode, as range decreases, the

collector of Q-1912 becomes more positive.

emitter of Q-1912 becomes more negative.

range strobe occurs further from the zero.

range strobe occurs closer to time zero.

th target video and the range strobe coincident
t lock on. The possible cause could be

Q-1907 open.

Q-1906 open.

C-1923 shorted.

Q-1904 open.

ecause of the action of K1901.

C-1923 and C-1925 are utilized in the FIRE CO

C-1923 and C-1925 are utilized in the BOMB DI

C-1922 and C-1924 are utilized in the FIRE CO

d. maximum of 247.2 μsec in duration.

24. DL-1901 is used to

a. delay the video.

b. shape the video.

c. delay the range strobe.

d. shape the range strobe.

24. CR-1901 is

a. conducting when range strobe is present.

b. cutoff when range strobe is present.

c. conducting when video is present.

d. cutoff when video is present.

26. The waveform observed at J-1906 is

a. positive, 2 μsec, at time zero + range +

b. positive, 1 μsec, at time zero + range.

c. positive, 2 μsec, at time zero + range.

d. negative, 2 μsec, at time zero + range.

27. Q-1927 will

a. saturate at breakaway range.

b. cutoff at breadaway range.

c. conduct at acquisition.

d. cutoff at acquisition.

28. What types of signals are necessary to make and right?

ls the purpose of conical scan?

2.9.1 Given the 11D13 Maintenance Handbook, the
and a list of statements concerning the fu
the block, MATCH the name of each block to

2.9.2 Given the 11D13 Maintenance Handbook and a
statements concerning the functions of the
symbols, MATCH the symbol name to its func

2.9.3 Given the 11D13 Maintenance Handbook and
depicting the sequencing and display durat
A-Gun symbols, SELECT the correct drawing.

2.9.4 Given the 11D13 Maintenance Handbook and T
Symptoms, SELECT from a list the faulty co
in the:

a. 500 Hz Reference Oscillator (A1501)
b. Gate Multivibrator (A1502)
c. Amplifier Gate Generator (A1503)
d. Breakaway Generator (A1505)
e. Range Circle Generator (A1506)
f. Buffer Amplifier (A1510)
g. Vertical Gate (A1507)
h. Horizontal Gate (1508)
i. Blanking Generator (A1504)
j. A-Gun Driver (A1509)
k. Pedestal Amplifier (P/O A1518)
l. A-Gun Deflection Amplifier (A1520)

TUDY ASSIGNMENT:

Read: Maintenance Handbook Device 11D13A, NAV
P-2974-1 and 2.

omplete: Student Activity Guide 12.9.1S

UDY QUESTIONS: None

Aim dot, artificial horizon, range circle.bre
"X", clamp time.
Artificial horizon, range circle/breakaway "X
dot, clamp time.
Breakaway "X"/range circle, artificial horizo
dot, clamp time.

at is the vertical component of the range circl

500-Hz sinewave leading the reference +45°.
The 500-Hz reference sinewave.
500-Hz sinewave lagging the reference -45°.
A 500-Hz sinewave 180° out of phase with the

en is relay K-1501 energized?

B/D.
PPI.
Lock-on.
Breakaway.

en is relay K-1503 energized?

Lock-on.
Breakaway.
PPI.
B/D.

at is the horizontal component of the horizon l

500-Hz sinewave in phase with the reference.
500-Hz sinewave lagging the reference -45°.
500-Hz sinewave leading the reference +45°.
500-Hz sinewave 180° out of pahse with the re

at is the A-Gun control grid used for?

Focus.
Astigmatism.
Unblanking.
Deflection modulation.

8. The steering dot would _____ when deenergized.

   a. always be displayed
   b. never be displayed
   c. not be affected
   d. appear intermittently

9. What is displayed by the A-Gun in the FIR AUTOMATIC TRACK sub-mode?

   a. Artificial horizon line only.
   b. Artificial horizon line, steering dot
   c. Range circle, artificial horizon line
   d. The A-Gun is disabled in this sub-mod

10. Total cycle time for the A-Gun is

    a. 4 ms.
    b. 8 ms.
    c. 12 ms.
    d. 16 ms.

11. Output, pin number 16, gate multivibrator to the

    a. dot gate/circle gate.
    b. circle gate/horizon line gate.
    c. horizon line gate/clamp gate.
    d. dot gate/horizon line gate.

12. A-Gun driver A-1509 is used to

    a. invert the input.
    b. provide push-pull outputs.
    c. amplify the input.
    d. isolation between A-1520 and A-1508/A

13. The frequency of the Wien-bridge oscillat

    a. 1000 Hz.
    b. 1500 Hz.
    c. 500 Hz.
    d. 250 Hz.

. vertical position.
. horizontal position.
. shape.
. diameter.

he signals needed to produce a circle on an osc
re

. two sawtooth 90° out-of-phase.
. two sinewaves 90° out-of-phase.
. two sawtooth 180° out-of-phase.
. two sinewaves 180° out-of-phase.

10 (A-1505) is used for

. balancing of T1 output.
. biasing of steering diodes CR1-CR2.
. phase lagging.
. differentiation.

o what element of the A-Gun is this waveform"
pplied?

"

. Cathode.
. Horizontal deflection plates.
. Vertical deflection plates.
. Control grid.

he purpose of the A-Gun portion of the buffer a
A-1510 is to

. gate the A-Gun.
. amplify the buffer.
. isolate the antenna from the 1500 unit.
. apply jizzle to the "B" trace.

he purpose of CR-1 and CR-2 (A-1502) is to

. couple the negative going swings of Q2's col
  flip-flop #2.
. limit the incoming signal.
. clamp the collectors of Q3 and Q4 to ground.
. provide a d-c bias stabilization reference p

21. The vertical gate (A-1507) is composed of

    a. OR gates.
    b. NOR gates.
    c. AND gates.
    d. NAND gates.

22. K-1501 pins 14, 15, and 16 (A-1507) provid
    for the proper operation of steering diode

    a. reverse bias.
    b. ground.
    c. forward bias.
    d. an a-c reference

23. The input to steering diodes CR4-CR3 (A-15
    aircraft was rolling, would be

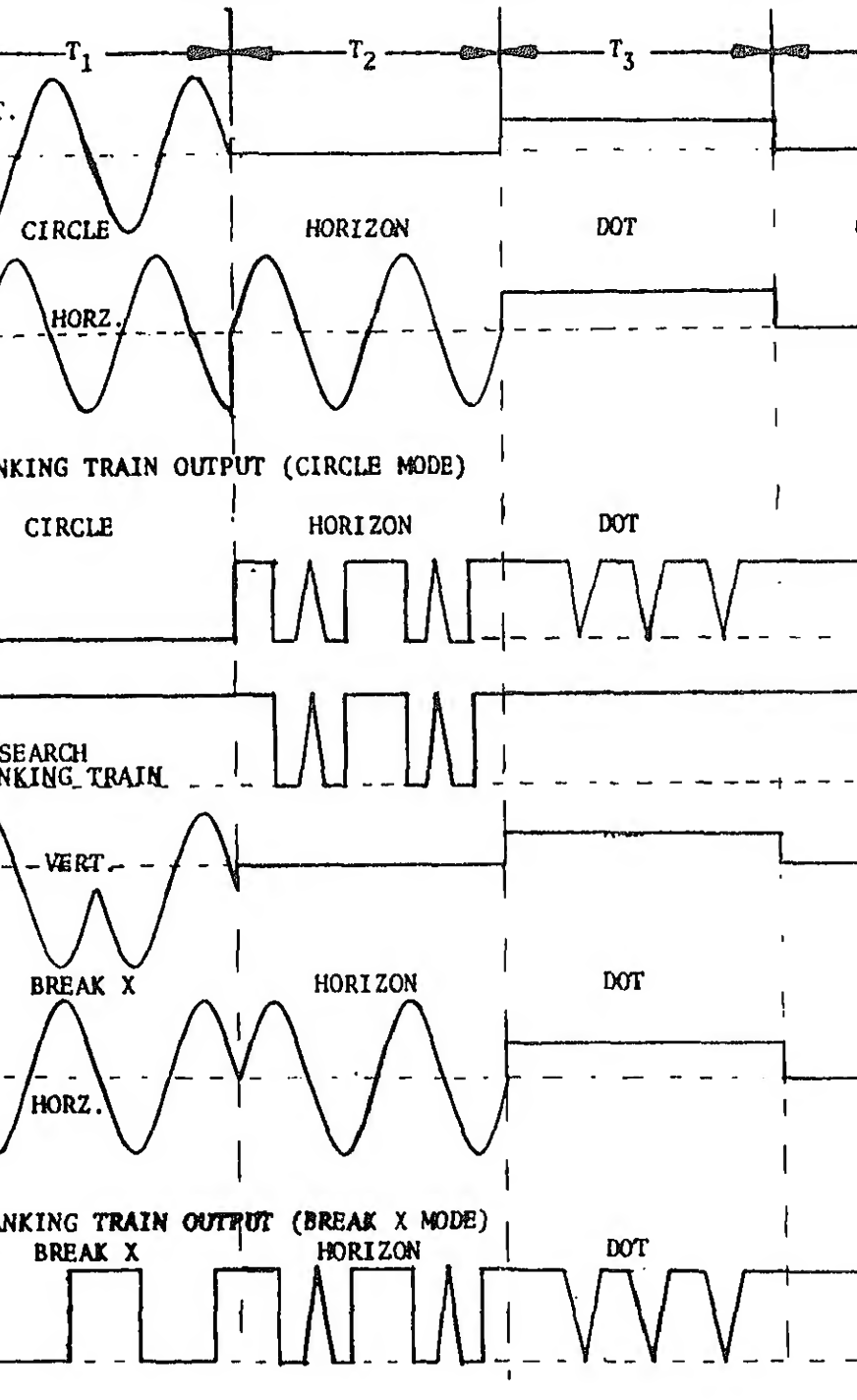
    a. d-c level.
    b. Ø.
    c. pulsating d-c.
    d. sinewave.

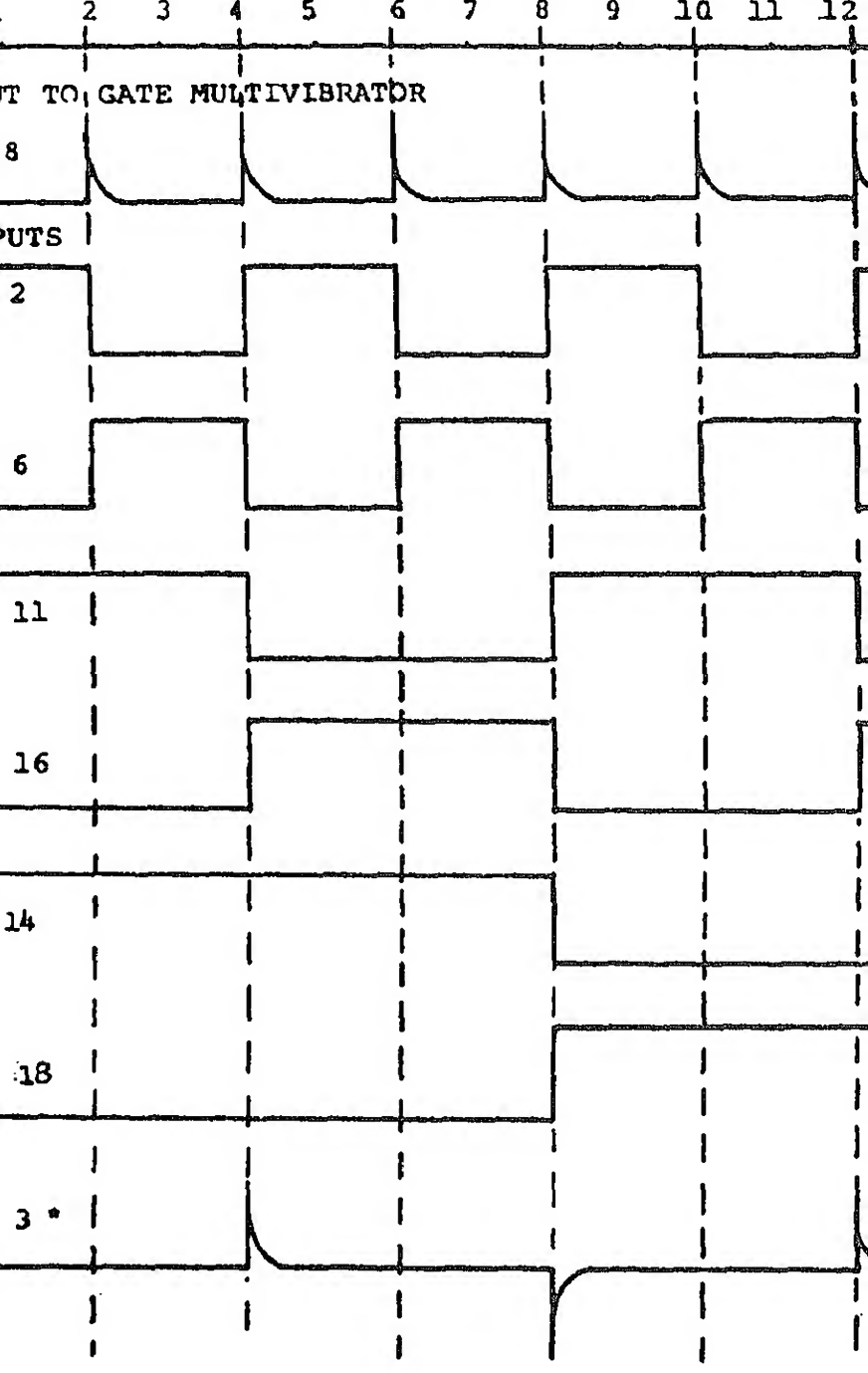
24. Both inputs to Q4 (A-1507) would be negati

    a. T_1.
    b. T_2.
    c. T_3.
    d. T_4.

25. R12 Q3 (A-1509) is adjusted for

    a. d-c gain balance between Q2 and Q3.
    b. +10V d-c.
    c. -10V d-c.
    d. Ø volts.


T1
T2
T3
CIRCLE
HORIZON
DOT
HORZ.
NKING TRAIN OUTPUT (CIRCLE MODE)
CIRCLE
HORIZON
DOT
SEARCH
NKING TRAIN
VERT.
BREAK X
HORIZON
DOT
HORZ.
NKING TRAIN OUTPUT (BREAK X MODE)
BREAK X
HORIZON
DOT



with A1504 Blanking Generator removed from the circuit.

the 11D13A Maintenance Handbook, the block dia
list of statements concerning the functions of
s, MATCH the name of each block to its function

the 11D13A Maintenance Handbook and a list of
ments concerning the functions of the three B C
ls and the video, MATCH the symbols and video t
ion.

the 11D13A Maintenance Handbook and four drawi
ting the sequencing and display duration of the
ymbols, SELECT the correct drawing.

the 11D13A Maintenance Handbook and Trouble
oms, select from a list the faultly component(s
f the following:

ange Sweep Generator (A1511)

eak detector (A1513)

cquisition Symbol Generator (A1514)

orizontal Switch (A1517)

-Gun Deflection Amplifier (A1519)

uffer amplifier (A1510)

edestal Amplifier (P/O A1518)

0 KHZ Oscillator (A1515)

0 KHZ Multivibrator (A1516)

NT:

Maintenance Handbook Device 11D13A, NAVTRADEV
P-2974-1&2, PP. 3-42 through 3-52.

Aviation Fire Control Technician 3 & 2, NAVPE
10387, pp. 478-481.

PPI indicator.
A-gun and B-gun.

anking for the range sweep display is obtained b
ying the range gate from _____ of A-1511 thr
pedestal amplifier to the _____ of the B-gu

pin 2; cathode
pin 9; control grid
pin 2; control grid
pin 9; cathode

sharing for display of the acquisition symbol i
iated by the range gate to pin _____ of th
_____.

5; A-1514
2; A-1514
3; A-1511
2; A-1511

many outputs are there from the 20-KHZ oscillato
515)?

1.
2.
3.
4.

he A-1511 unit, Q2 and Q3 and associated circuit
up a/an _____ multivibrator.

monostable
bistable
astable
free running

in the A-1519 unit is a

BALANCE control.
CENTERING control.
GAIN control.
TIME control.

a. blanking the B-gun during range trace ti
b. blanking the B-gun during acquisition ga
c. unblanking the B-gun during range trace
d. unblanking the B-gun during acquisition

9. Q2 of the A-1514 will be cut off

a. at the end of range sweep time.
b. 100 μsec after range sweep time.
c. at time zero.
d. 300 μsec after range sweep time.

10. CR5 of the A-1514 unit will

a. be conducting when Q4 is cut off.
b. be cut off when Q4 is conducting.
c. be conducting when Q4 is conducting.
d. never be cut off.

11. The amplitude of the signal at pin 9 of A-1
determine the

a. length of the acquisition symbols.
b. spacing between the acquisition symbols
c. horizontal position of the acquisition
d. vertical position of the acquisition sy

12. The signal at pin 3 of A-1516 is a

a. 20-KHZ square wave.
b. 20-KHZ sine wave.
c. 10-KHZ square wave.
d. 10-KHZ sine wave.

13. When the acquisition gate is present at pin
which of the following conditions exist? (
A-1517 unit.)

a. CR3 gated on, CR4 gated off.
b. CR3 gated off, CR4 gated on.
c. CR3 gated on, CR4 gated on.
d. CR3 gated off, CR4 gated off.

voltage

proportional to the range selected by the range
switch S-1502B.
proportional to the electrical length of the ra
trace.
proportional to the delay between the input tri
and the range strobe.
used to horizontally position the acquisition s

acquisition symbol horizontal spacing is determ
ne

20 KHZ sine wave at pin 7 of A-1515.
20 KHZ sine wave at pin 5 of A-1516.
10 KHZ square wave at pin 3 of A-1516.
20 KHZ square wave at pin 11 of A-1515.

the range strobe appears at pin 5 of A-1513, i
which of the following conditions to exist?
.)

Q1 conducts, Q2 cut off.
Q1 cut off, Q2 conducts.
Q1 cut off, Q2 cut off.
Q1 conducts, Q2 conducts.

of the following controls is adjusted so the
starts at the bottom of the indicator?

R7 in the A-1511 unit.
R19 in the A-1519 unit.
R4 in the A-1519 unit.
R11 in the A-1519 unit.

many inputs to the A-1515 unit?

None.
1.
2.
3.

synchronizer to trigger the B-gun circuitry

IC LEARNING OBJECTIVES:

Without the aid of notes , define organizati
nance.

List the steps in the four step fault insola
ure.

State the purpose for verification of reporte
pancies.

State which step in fault isolation procedure
tional, functional and preflight checks emplo

State the purpose of a spectrum analyzer.

State the purpose of TDR and FDR.

State the purpose of multimeters.

State the purpose of a megger.

State the definition of intermediate maintena
ties.

List the test equipment normally used in IMA
shooting.

List the test equipment normally used in modu

State the purpose of warnings in MIMS

State the purpose of cautions in MIMS.

GNMENT: Read Information Sheet 12.11.1I
Complete Student Activity Guide 12.11.1

TIONS: NONE

TRODUCTION: The following information sheet wi
maintenance level and intermediate
The information below is only basi
coursed in Reference: NAVPERS 103
Control Technician 3&2.

FORMATION:

All the technical knowledge in the world is of
the maintenance of complex systems without a l
of this knowledge to keep the system in operat
many methods of maintaining these systems as t
cians. However, in many cases these methods a
arranged to arrive at the necessary conclusion
est efficiency. All of these methods are, to
or in different sequences, a basic four-step m
step method entails:

a. Verifying that the reported discrepancy do

b. Isolating the cause of that reported discr

c. Repairing the cause of that discrepancy.

d. Rechecking the system to ensure that the d
corrected. This four-step method can be appli
of maintenance.

Organizational Maintenance Activities (OMA)

A. Verification of the discrepancy at this le
by performing operational and functional c
all system as installed in an aircraft.

b. Isolation of the discrepancy is accomplish
voltage checks and continuity of interconn

c. Repair of the discrepancy at this level of
changing an Aircraft Replaceable Assembly
ing cable repair or replacement of fuses,

d. Once the repair has been effected, it is n
system be operationally and functionally c
to ensure that it is in all respects opera

Intermediate Maintenance Activities (IMA)

a. At this level of maintenance, it is necess

isolate the discrepancy, requires signal traci
ubassembly to subassembly), voltage checks and
ity of chassis wiring.

ce the discrepancy is isolated, the repair of t
ll entail the replacement of a subassembly, the
assis wiring or the replacement of internal com

ce again, just as the Organizational level, aft
pair has been effected, it is necessary that th
mpletely rechecked to ensure proper operation.

repair is accomplished by the same four-step m
s to Organizational and Intermediate Maintenanc
ler scale.

plication of this aforementioned four-step meth
ng has been simplified by the layout of Mainten
ction manuals for particular aircraft or system
ay be. These manuals contain:

troduction to the aircraft or system.

uipment lists and locations.

ult isolation tables.

gnal flow diagrams.

terconnecting diagrams.

ring diagrams.

hematic diagrams.

ist the technician in the logical troubleshooti
recommended that some form of data sheet such a
be initiated and utilized. These data sheets n
printed sheet. This same information can be r
n paper if necessary, for the purpose of remind
of those checks that have been performed (and
ose checks which have yet to be performed.

"LEFT BLANK INTENTIONALLY"

ted discrepancy:

leshooting procedure:

erification of discrepancy:

. Operational check Analysis _____

. Functional check

(1) _____ Analysis _____

(2) _____ Analysis _____

(3) _____ Analysis _____

solation to a unit:

Test point taken	Reading observed	A
_____	_____	_
_____	_____	_
_____	_____	_
_____	_____	_
_____	_____	_
_____	_____	_

Defective unit _____ P/N _

ake necessary repairs and/or replacement of unit
roceed to make necessary final adjustments to me
erformance standards.

uality Assurance Inspection

_____ _____

Inspector Date

PCN UNIT/SUBASSEMBLY/MODULE NO.

A. Reported discrepancy:

B. Troubleshooting procedure:

1. Verification of discrepancy:

	Test point taken	Reading observ
a.	_____	_____
b.	_____	_____
c.	_____	_____
d.	_____	_____
e.	_____	_____

2. Isolation to a module/stage:

	Test point taken	Reading observ
a.	_____	_____
b.	_____	_____
c.	_____	_____
d.	_____	_____

Defective module/stage _____

3. Isolation to a component:

a. Visual inspection A

b. Signal tracing

age readings

Test point taken	Reading observed	Analysis

stance readings

Test point taken	Reading observed	Analysis

Bad component Nomen. _____ P/N _____

essary repairs and/or replacement of parts. The
to make necessary final adjustments to meet mini
nce standards.

Assurance Inspection

_____ _____

Inspector Date

c. 1400 unit

d. 1600 unit

. During OMA troubleshooting you find there are displayed. There is a faulty output from J14 The most probable failed unit is?

a. 1400 unit

b. 700 unit

c. 1500 unit

d. 1600 unit

. The voltage across pins C and AA, J701 is 185 reason could be? pg 59/60

a. F 705 open

b. R 736 open

c. CR 701 opne

d. Normal operation.

. While isolating to a stage in the 1600 unit y from Q1610. Also there is no output from any probable cause would be?

a. Delay multivibrator Q1606, Q1607

b. Schmitt trigger Q1603, Q1604

c. 1-kc reference oscillator Q1601, Q1602

d. Emitter follower Q1605.

The PPI to be disabled.

CR2 on the A1513 board were to open it would c
following?

No blanking of the acquisition symbols

No vertical movement of the acquisition symbo

No horizontal movement of the acquisition syml

No horizontal movement of the 'B' sweep

ossible cause of no range circle being displaye

R15 on the A1501 board fully counter-clockwise

R24 on the A1506 board fully clockwise

R6 on the A1506 board fully counter-clockwise

R17 on the A1506 board fully clockwise

re is 25 VDC on the collector of Q2 of the A15
sible cause could be?

Q2 shorted emitter to collector

R1 A1511 board shorted.

Q3 A1511 board shorted.

R5 A1511 board open.

ing an operational check, all PPI indications
in bomb director there is no range cursor and
no vertical movement of the acquisition symbol
bable failed unit would be?

1500 unit

1900 unit

1400 unit

1600 unit

No target is being displayed on the indicators, a
cations are normal. The most probable cause would

a. V1412 pin 1 open

b. V1412 pin 2 open

c. V1413 pins 2 & 9 open

d. R14111 fully clockwise (pin 2 toward pin 1)

If R1514 were misadjusted, pin 2 toward pin 3. T
would be? pg 71/72

a. No circle

b. No break X

c. No ⊿F lines

d. No 'A' gun display

In the A1502 board, if Q2 opened what would be fe
collector of Q.

a. ground

b. +28 VDC

c. 2 MS pulse

d. 4 MS pulse

In the BD mode of operations there is no depresse
most probable cause would be?

a. K1404 energized.

b. R1433 out of adjustment

c. R1434 out of adjustment

d. Normal operation for BD mode.

DELETED

ODUCTION:

During the study of the 11D13, we have discussed
circuits within these units which generate the d
forms needed in a radar system. It is important
be able to check and maintain these typical circ
hands-on experience you receive from this lab it
use the necessary test equipment and procedures
troubleshoot the 11D13 trainer.

ON TOPIC LEARNING OBJECTIVES:

3.1 With the aid of a job sheet, analyze wav
the synchronizer unit.

3.2 With the aid of a job sheet, analyze wav
range angle track unit.

3.3 With the aid of a job sheet, analyze wav
the A-gun.

3.4 With the aid of a job sheet, analyze wav
the B-gun.

3.5 With the aid of a job sheet, analyze wav
the A-scope.

3.6 With aid of a job sheet analyze the indi
each mode and submode of operation of th

RENCES:

1. NAVTRADEV P-2974-1, Maintenance Handbook, Vo
Dec., 1968.

2. CNTT-M649, Airborne Radar System Trainer Dev
schematic diagram.

PMENTS AND MATERIALS

1. 11D13 Radar Trainer
2. Oscilloscope, Tektronic 453

STEPS:

1. Preliminary Procedure

a. Safety

(1) Ensure all watches and rings are re

: All probes used in this lab and throughout

(2) Turn on target generator (2300) unit

(a) Set RANGE CONTROL knob to less than
yds.

(b) Set TARGET SIZE knob to max.

(c) Do not set ELEVATION CONTROL knob, l
position found at start of lab.

(d) Do not set TARGET BEARING control kn
in position found at start of lab.

(e) All toggle switches in the UP positi

(3) Synchronizer controls (1600)

(a) LOCAL-REMOTE switch to LOCAL positio

(b) RANGE toggle switch (6,000/12,000) i
yd position.

(c) VARIABLE RANGE MARK knob (labeled 1-
to 1000 yd position (each number rep
times 1000 yds).

(4) Indicator video controls

(a) SERVO toggle switch to OFF position.

(b) RANGE switch S-1401 (five position s
40,000 yd position.

time this switch, S-1401, is changed, the range s
0 unit must be changed to correspond with it.

(c) VIDEO AMPLITUDE knob R-1411 to max.

(d) RANGE MARK AMPLITUDE R-14108 to max.

(e) SCAN CONTROL switch (toggle type) S-
SECTOR position.

(f) SCAN RATE knob (R-1452) to AUTO posi

(g) MODE SELECTOR switch; S-1406, to FC
control)

(2) Mode - CHOP

(3) Sweep time/div. - .2ms

(4) Horizontal display - A

(5) A triggering

(a) Slope - (+)

(b) Coupling - AC

(c) Source - Ext.

(6) A sweep mode - AUTO TRIGGER

(7) B triggering

(a) Slope - (+)

(b) Coupling - AC

(c) Source - Int.

(8) Connect coax synch cable between A-tri input and J1603 of trainer

d. STANDBY position must be used when trainer attended.

(1) Trainer

(a) High voltage switch on power suppl

(b) 1400 unit (indicator video) - SER

(c) 1500 unit (indicator display) - al fully CCW. (down)

(d) All modules secured and drawer pus

(2) Oscilloscope

(a) INTENSITY fully CCW (down)

(b) Probes removed from trainer, coile on top of bench.

gs.

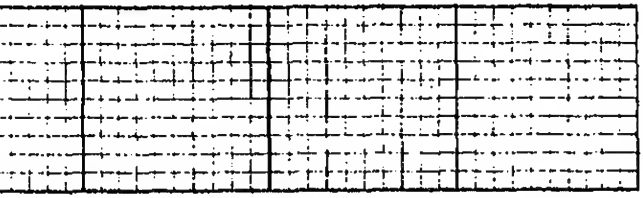
nchronizer (1600 unit)

) Basic trigger

(a) Connect oscilloscope probe to TP1605 usin .2ms/div. and .5 volts/div. (All test poi 1600 unit are located on front of unit)

(b) Adjust R-1603 for a PRF of 1 kHz

(c) Record adjusted waveform in space provide Label all waveforms in PRT, amplitude and

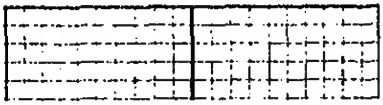


TP160

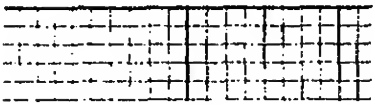
) Output Triggers

(a) Channel 1 probe to TP-1619, Channel 2 pro TP1610. Use 2ms/div. and 1 volt/div.

(b) Adjust R-1625 max CW and record waveform. as before plus delay and pulse width

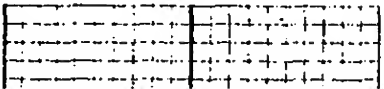


TP161



TP161

(c) Adjust R-1625 max CCW and record waveform label as above.



TP161

(3) Ringing oscillator

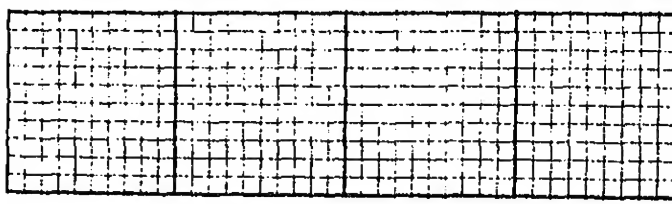
(a) Connect o-scope to TP1613; channel .5 volts/div and 20μs/div.

(b) Adjustments

1. L-1601 for PRF 161.8kHz (using

2. R-1639 for pulse train flat to 80μs. (using 20μs/div)

3. Record waveform and label as a



_____PRT Flat Top _

Train widt

_____Amount delay front TØ Amplitude _

4. Range Marks

a. Connect o-scope channel 1 using 2Ø s/div and .5 volt

Remember all voltages must be multiplied by ten due to the use of 10:1 probes.

b. Compare the pulse train wa channel 2 to the range mar channel 1.

c. VRM minimum range (variabl

1) R-1667 (VRM Pot.) set painted numbers around

2) Adjust R-1668 to coinc pulse, or max CW if VR reach second pulse.

with 7th pulse.

e. S-1602 (RANGE MARK INTERNAL swit
1000 yds,

1) Measure and record PRT

_____ 100

f. S-1602 to 2000 yd position

1) Measure and record PRT

_____ 200

g. S-1602 to 3000 yd. position

1) Measure and record PRT

_____ 3000

5. Doppler circuits

a. Set o-scope

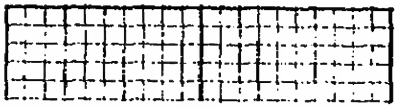
1) Channel 1 to TP1623, use 20
1 volt/div

2) Channel 2 to TP1622, use 20
1 volt/div.

b. R-1667 to 1000 yds

1) Record waveform, amplitude
width at TP1623 and TP1622
measure only the delay for

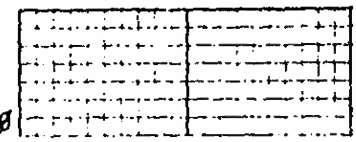
000 yds



TP1623 PW _

TP1622 PW _

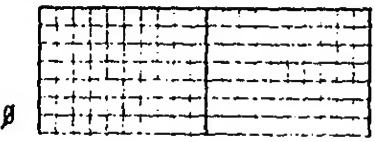
1) Record waveform and m
width



TP1627 P

f. R-1667 to 12000 yds.

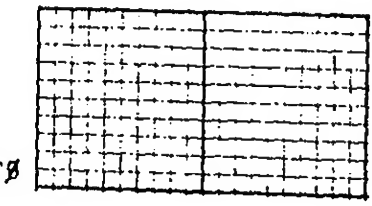
1) Record waveform and m
width at TP1627.



TP1627 P

a) Note: The change
waveform compared
channel 2.

g. RANGE switch (S-1604) to



1) Record and measure wa

TP1627 P

a) Vary R-1667 from
yds and note the
1's waveform com
channel 2.

b) Note: The chang
between TP1627 i
position and TP1
yd position.

b. Why is there a delay before t
oscillator starts oscillating
does the ringing oscillator's
train eventually become?

c. Why is the VRM adjusted to th
mark for minimum and the 13th
imum in the 12,000 yd range p

Instructor Verification· _____
I

PPI circuits (planned position indicator)

(1) Preliminary procedure - indicator units

(a) 12,000 yd. range on 1400 unit and 150
switches. (S-1401 & (S-1502)

(b) SCAN CONTROL switch (S-1405) to PPI p

(c) HIGH VOLTAGE switch (power supply; 70

(2) Laboratory experiment.

(a) Sweep deflection N-S.

1. O-scope set up

a. .1ms/div.

a. PPI INTENSITY UP so sweep is vis
scope.

b. AUTO/MAN scan select switch to M
(1400 unit)

c. SERVO switch (1400 unit) to ON

d. Adjust sweep to 0^{o} by turning SC
control knob left or right until
at the top of scope and centered

e. Turn SERVO switch (1400) OFF

1) Sweep should now be centered
stationary.

3. Adjust R-1433 so that last (fourth i
position) fixed range mark is just v
top of CRT mask.

4. Adjust R-1418 so that channel 1 and
waveforms are identical in shape.

(b) Sweep deflection E.W.

1. Set sweep position on "A" scope manu
90^{o}. (Follow same procedure as used
to 0^{o})

2. O'scope

a. Channel 1 to TP1405

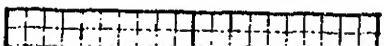
b. Channel 2 to TP1406

3. Adjust R-1476 so that signals at TP1
TP1406 are identical in shape.

4. Adjust R-1479 so that the sweep (on
is centered and extends so that the
range mark is just visible at edge o

5. Record waveforms at TP1403 and TP140

TP1403 Amplitude ___



PRT ___

1. Reset sweep position (on "A" s

2. Select range mark interval for

3. Adjust R-1401 so the 12th rang
edge of mask.

4. Reset sweep position to 90°

5. Adjust R-1451 so that 12th ran
edge of mask (do not count the
scope as a range mark)

(d) BD MODE (Bomb Director)

1. Controls

a. Set RANGE at 40,000 yds. (
must be selected on 1400 a

b. BD AZIMUTH MARKER control
ed position

c. SCAN CONTROL switch to SEC

d. MODE SELECT switch to BD.

2. Adjust R-1434 so the sweep sta
of scope.

3. Waveforms

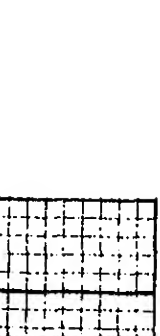
a. Channel 1 probe to TP1402

b. Remove channel 2 probe fro

c. Set o-scope to 2 volts/div

d. Observe wavefroms in all f
positions (in 80,000 yd p
o-scope to 5 volt/div and

e. Record waveforms for each
measure amplitude and swee



6000 yds

Amp _____

Duration _____

80,000 yds
(5v/Div)

Duration ___
Amp _____
Duration ___

NOTE: Bomb director mode not used i
12,000 yd position only 10,00
80,000 yd positions. When tr
use 40,000 yd position. Note
are in 6000 yds and 12,000 yd
only.

(e) Repeat afore observation, measuremer
for FC Mode. (Change MODE SELECT swi
FC). Reset O-scope to 2 volts/Div.

6,000 yds — Amp _____ Duration ___

12,000 yds — Amp _____ Duration ___

10,000 yds — Amp _____ Duration ___

40,000 yds — Amp _____ Duration ___

80,000 yds — Amp _____ Duration ___

Instructor Verification ____

c. Range/Angle Tracking (1900 unit)

(1) Preliminary procedures

(a) Place trainer in FIC mode, 40,000 y

(2) Laboratory assignment (The 19000 unit w
power removed.) Make no adjustments on

(a) Observe TP1934 (set o-scope to 20μs
2 volts/div.

PW _____ Amplitude _____

bserve TP1924

Measure sweep duration and record

Switch to BD mode, measure sweep duration an record

BD _____ FC _____

Reselect FC Mode

ange integrator output

Go to TP1910

a. Set o-scope to DC input, 1 volt/div.

b. Turn R-1461 fully CCW. (0 yds)

c. Measure and record DC level

_____

d. Turn R-1461 slowly CW and observe change in DC level. When fully CW measure and record DC level. (Fully CW equals 40,000 yds)

ock-on (aquistion)

Lock trainer on to target video by placing acquistion symbols over target (Note: Acq. symbols may have to be placed slightly above or below target in order to lock on).

Observe waveform at TP1927

Turn RANGE RATE toggle switch on 2300 unit down. (First-center switch on left)

Radar should track down in range (Note chang in waveform).

Break-X should appear when radar has tracked to 3500 yds.

TP1906 formed?

Instructor Verification ___

d. A-CUP circuits (1500 unit)

(1) Preliminary procedures

(a) Set up

1. 40,000 yd range

2. FC Mode

3. External synch for o-scope to A jack. (located front bottom ce unit just in front of K1501.

(2) Laboratory experiment.

(a) Drop A-1501 board down (500 Hz Osci

NOTE: Warning- Turn power OFF (low and high v removing (pull down) boards.

1. Set o-scope .5ms/div and .5 vol AC.

2. Channel 1 probe to D20 (pin num

3. Channel 2 probe to F17

4. Adjust R-4 for 2ms PRT (pos. pu

5. Adjust R-12 for 9v P.P. (sinewa

6. Channel 1 to R-15 pin 2 (wiper

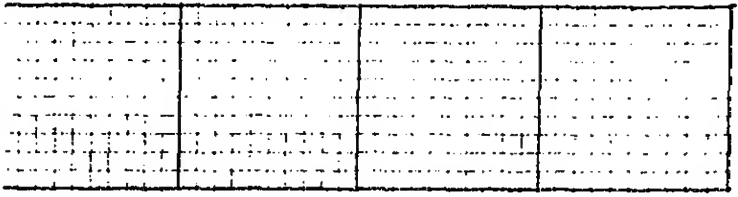
1. Set o-scope to .1 volt/div.

CAUTION: Do not take measurements on o-scope div.

7. Adjust R-15 for 1 volt P.P. sin

8. Record the three waveforms (2

R15
(Pin 2)



9. Put A1501 Board back up and pull down A1502 board. (Remember turn OFF power before pul down or putting up boards).

A1502 Board (Gate Multivibrator)

Never pull two boards down together. If necess to take readings on different boards at the sar time pull one board down, clip probe to test po replace board with probe attached then pull dow second board.

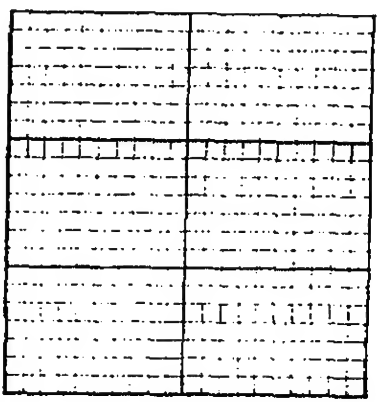
1. Channel 1 to F15

2. Channel 2 to F8

3. Record both waveforms using F15 as referenc (label AMP, PW & PRT)

4. Channel 2 to A-7

5. Record



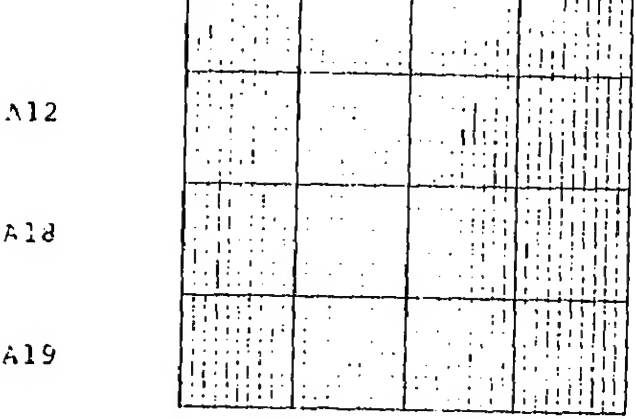
F15

A7

F8

the rest of the A-Gun section have trainer lo

Blanking Circuits (A1503 Amplifier Gen. and A15
Blanking Gen.)



2. Adjustments

a. Channel 1 to TP6 (.2ms/div and .2 volts/div)

b. Adjust R-15 fully CCW

c. A1503 adjust R-19 for a 1ms posit pulse width. (Replace A1504 and A1503 for adjustment, then replac and drop A1504).

d. A1504 adjust R-15 CW until a/.1ms appears in the positive pulse. (will be necessary to go to .1ms/d to adjust accurately).

e. Using procedure in step c. drop A adjust R-6 until gap is centered positive pulse (use .2ms/div.)

f. Replace board (DO NOT HAVE TWO BO AT ONCE)

g. A1504 TP Channel 1 (PRF) 2ms/div .2V/div.

1) Locate and label ALL parts (TP TUNE TP, LED, APT)

2) Replace A1507 board and drop A150

i. A1508 (Horizontal Gate)

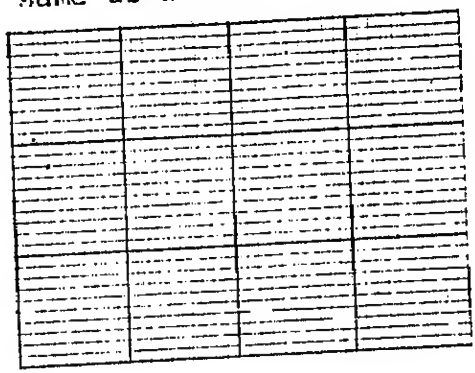
1) Attached channel 2 probe to A4

2) Record same as above

A1504 F5

A1507 A4

A1508 A4



j. Replace Board and break lockon.

k. Answer the following conclusions:

1) Why is the output of R-15 pin 2 adjusted (1v pp) to less amplitude tha F17 (9 v pp) on the A1501 Board?

2) What caused the positive pulse at A1504 A18?

3) Why did adjusting A1503 R-6 center GAP of the blanking signal?

Instructor Verification: _____
Initials

(a) Drop A1511 board down (Range Sweep

CAUTION: Ensure power switches are in OFF pos
down or putting up boards.

1. Attach o-scope probe to D18 (a

2. Adjust R-7 to set rise time (F

3. Put A1511 board back up.

(b) Drop A1515 board down (20kHz oscil

1. Set o-scope to .2 volts/div

2. Trigger source to INTERNAL

3. Synch by adjusting trigger le
probe attached

4. Attach probe to C11

5. Adjust R-13 so that signal is

6. Put A1515 board up.

(c) Drop A1517 board (Horizontal swit

1. Set FC sector center to ZERO

2. Set servo switch to ON

3. Set R-1460 (azimuth hand cont
degrees.

4. Adjust R-6 to position range
(D-scope) to zero degrees whi
depressed (this puts trainer

5. Adjust R-19 to position acqui
range sweep.

6. Depress R-1460 and turn fully

7. Adjust R-16 to position acqui
range sweep (while holding R-

2. Adjust R-19 until the length of range swee just fills mask.

3. Turn azimuth servo ON

4. Adjust R-11 so that range sweep horizontal travel goes to edge of mask left and right

5. Put A1519 board back in up position.

Drop a A1516 board (10kHz Oscillator)

1. Adjust R1 so acquistion symbols are visibl and not overdriven. (R1 is an amplitude adjust that controls intensity of acquis-tion symbols.)

2. Replace A1516 in up position

Drop A1515 board (20kHz Oscillator)

1. Adjust R-12 (phase shift adjust so that acquistion symbols have proper blanking (no bow tie).

2. Adjust R-13 so that acquistion symbols are approximately half an inch in length (vertically)

E: If there is only one acquistion symbol adjust R-2 so there are two.

3. Put A1515 board in up position.

Adjust R-1545 for a balance between range swee intensity and acquistion symbol intensity (R-1545 is located on the bottom of 1500 unit center line rear. Ensure the proper resistor is adjusted. Numbers are in front of the pot.

Drop A1511 board (Range Sweep Gen)

1. Adjust R-1461 MANUAL RANGE CONTROL CW (40,000 yds)

tor).

3. Replace A1511 in up position.

(i) Drop A1513 board (PEAK DETECTOR)

1. Adjust R-1461 fully CCW (zero yds)

2. Adjust R-3 so that acquistion symb
at bottom of scope. (zero adjust)

NOTE: The two prior adjustments may have to b
since they interact.

3. Replace A1513 board in up position

(j) Deflection waveforms FC search

1. Set o-scope to .1ms/div and 5 volt

2. SYNCH to EXTERNAL

3. Drop A1519 board (B-Gun Deflection

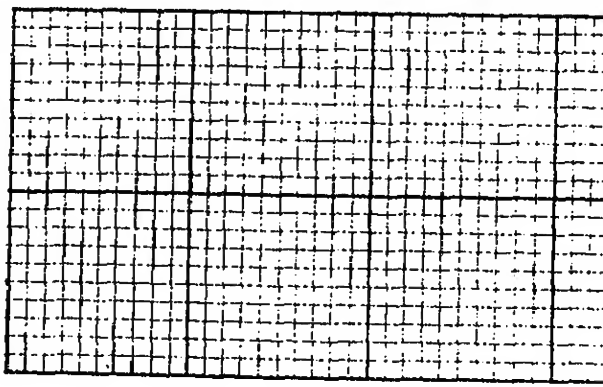
4. Channel 1 to C5 (vertical deflecti

5. Channel 2 to C13 (horizontal defle

6. Record waveforms and label all par

C5

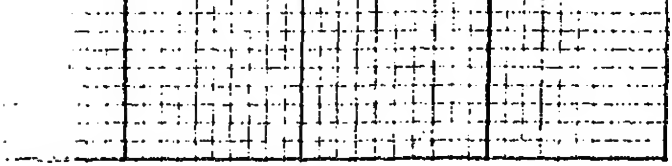
C13



7. Replace A1519 board in up position

(k) Blanking waveform FC search

F20



4. Replace A1518 board in up position

) Deflection waveforms FC track

1. Lock trainer onto a target (puts trainer i FC track)

2. Drop A1519 board

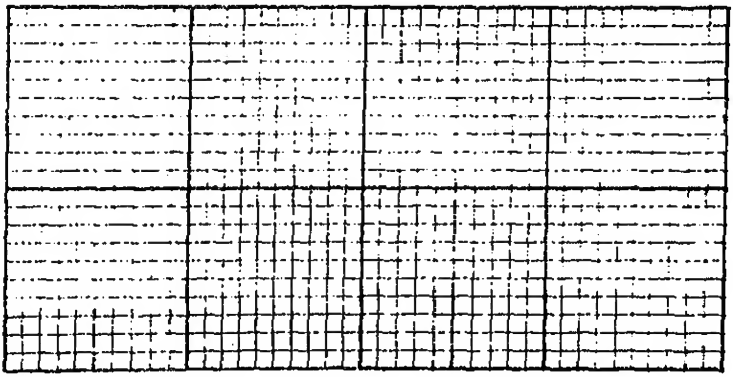
3. Channel 1 to C5

4. Channel 2 to C13

5. Record and label all parts.

C5

C13



6. Replace A1519 in up position

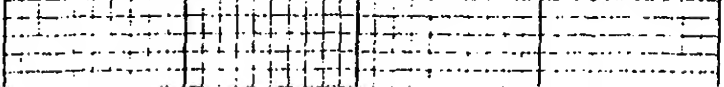
) Unblanking waveform FC track

1. Drop A1518 board

2. Channel 1 to F20

3. Record waveform and label all parts

F20



3. What characteristic of the ac
does the amplitude of the 10k
determine?

Instructor Verificati

f. Functional Check Scope presentations

(1) PPI search mode

(a) Controls

1. 12000 yd range

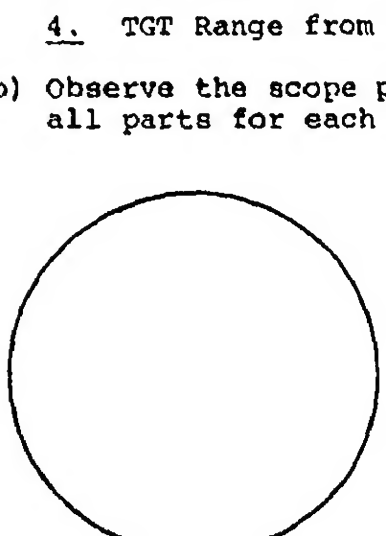
2. Scan-AUTO PPI

3. Mode FC

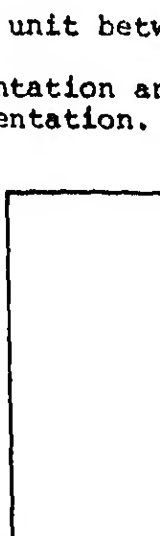
4. TGT Range from 2300 unit betv

(b) Observe the scope presentation a
all parts for each presentation.

PPI



A-scope

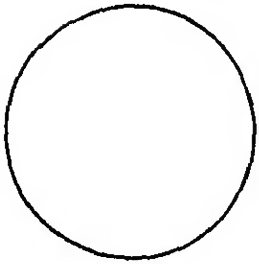


3. Mode - BD

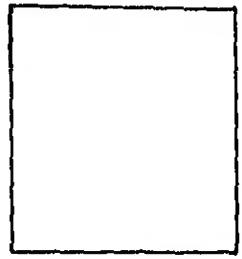
4. Target range - less than 20,000 yds.

5. Range cursor close to target.

(b) Observe and record presentation. Label all



A-scope



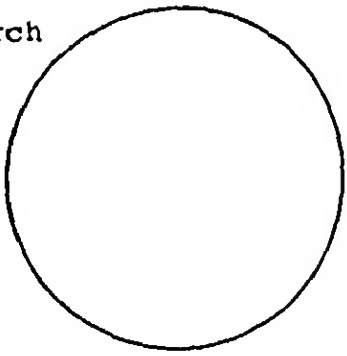
B-scope

) FC Mode (Search)

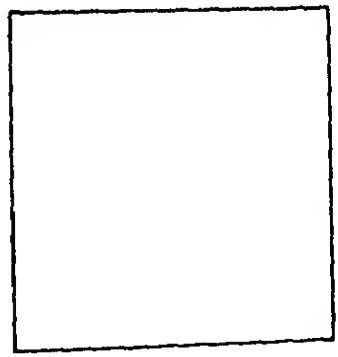
(a) Controls - same as BD except mode switch to

(b) Observe and record presentations. Label all

rch



A-scope



B-scope

) FC Mode track (Circle Submode)

(a) Controls same as search mode.

(b) Acquire and lock on target.

A-scope

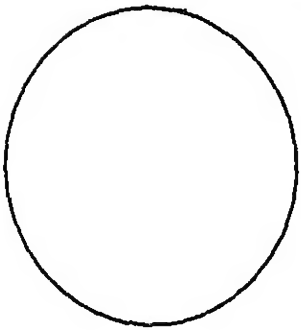
B-scope

(5) FC Mode track (break X submode)

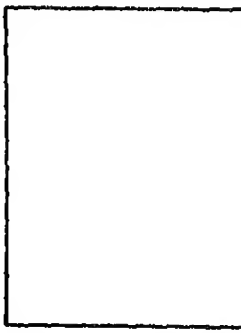
(a) Controls

1. Same as above except, turn range switch down. (RATE)

(b) Observe presentation as trainer trac down in range when break away occurs presentations.



A-scope



B-Sc

Breakaway occurs

(6) Conclusions

(a) What does B-scope presentation repre BD Mode?

NS:

important for the sweeps on the scope to start at
the transmitter fires?

he PPI indicator blanked?

width of the range strobe can be varied by what c

he bias input to the 500Hz oscillator used for?

oscillator (A-1515) is what type of oscillator?

isplayed by the A-GUN in PC track?

Instructor Verification _____
Initial

OPIC LEARNING OBJECTIVES:

Given 11D13 Maintenance Handbook and trouble s
select the proper test equipment and locate th
unit, module or component(s) in the 11D13 Rada
Document maintenance actions and follow approp
precautions.

Given the 11D13 Maintenance Handbook, verify t
malfunction by performing operational checks o
trainer. Record all malfunctions on the job s

Given the 11D13 Maintenance Handbook, locate t
unit by utilizing signal tracing, spectrum ana
voltage and continuity measurements as require

Simulate system repair at OMA level by orderi
ceiving new unit on VIDS MAF. Utilize studen
obtain codes required on VIDS MAF.

Given the 11D13 Maintenance Handbook, verify p
operation (malfunction corrected) by performi
checks on the radar trainer.

Given the 11D13 Maintenance Handbook, locate
module by utilizing signal tracing, voltage a
measurements as required.

Simulate unit repair at IMA level by ordering
new module on VIDS MAF. Utilize students gui
codes required on VIDS MAF.

Given the 11D13 Maintenance Handbook, verify
operation (malfunction corrected), by perform
operational checks required to check the unit
paired.

Given the 11D13 Maintenance Handbook, locate
component(s) by utilizing signal tracing, vol
tunity measurements as required.

0 Simulate module repair at IMA level by orderi
ceiving new component(s) on VIDS MAF. Utiliz
guide to obtain codes required on VIDS MAF.

epaired.

NAVTRADEV, p-2974-1&2 Maintenance Handbook Devi
December 1968.

Materials: Training Device 11D13

ional check

urn low voltage on; on power supply

ays turn the low voltage on first and listen fo

urn on high voltage.

urn on target generator

ode check

etup for PPI mode

1) Turn 1400 servo switch on.

2) Place 1400 range switch in 12,000 yd rd rang

3) Place PPI-Sector switch in PPI.

4) Place 1500 range switch in 12,000 yard range

5) Adjust PPI intensity and focus controls for
display.

heck PPI display for proper indications as show

ocument Indications presented on scope, using a

(3) Place B/D -FIC switch on 1400 unit to B

(4) Place 1500 range switch to 40,000 yards

(5) Adjust 1500 unit control for proper sco

b. Check B/D display for proper indications as

A-scope B-scope

c. Document indications presented on scope, us forms.

Instructor initials

. F/C Mode

a. Set up for F/C mode

(1) Place B/D-FIC switch on 1400 to FIC

(2) Adjust 1500 controls for proper displa

b. Check FIC auto search for the following inc

A-scope B-scope

Instructor initials

e. To get to breakaway X submode, place the ra
on the 2300 unit to the down position.

f. Check the breakaway X submode for the follo

g. Document indication presented on scope usin
forms.

Instructor initials ___

If the indications are bad (1 or all) then do t
for OMA

a. OMA

(1) Isolate to a unit documenting all neces

(3) Isolate to a component by signal tracing, readings and resistance readings and docu

(4) Order IMA part documenting proper paperwo

(5) Sign off IMA MAF

Instructor initials _____

ST ITEMS:

t range should be selected for the FIC mode?

ere are the intensity controls located (unit#)?

at is the proper sequence for turning power on?

Instructor initials _____
